The Space Congress® Proceedings

1996 (33rd) America's Space Program -What's Ahead?

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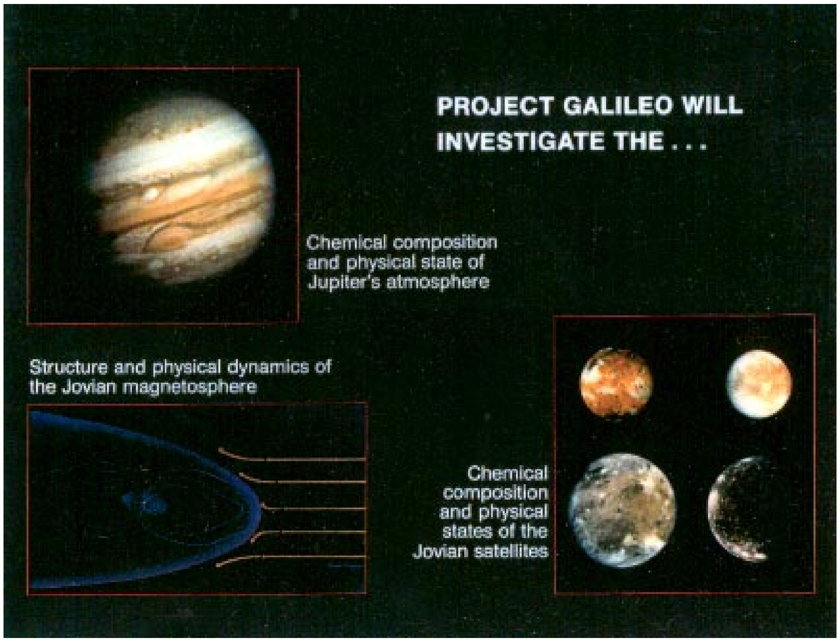
Paper Session II-A - Project Galileo

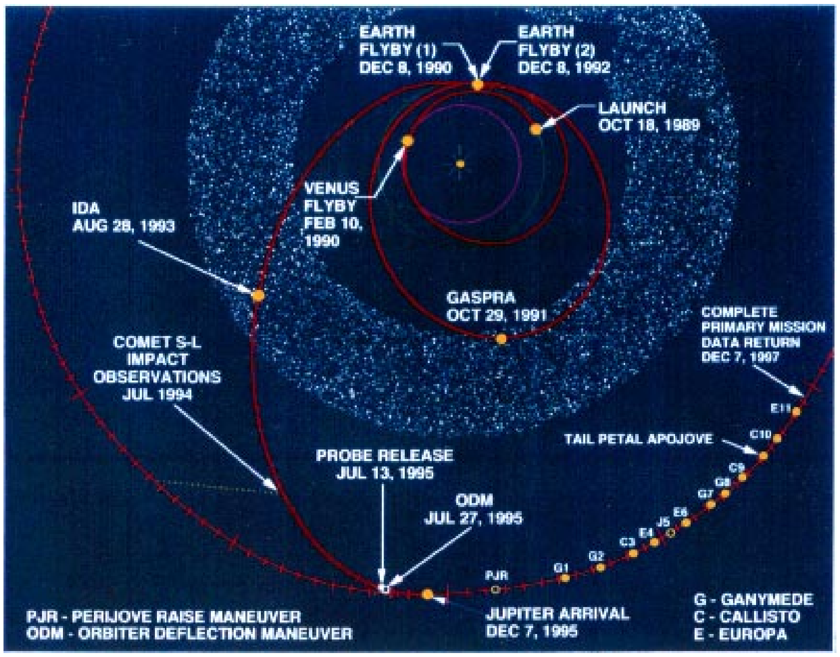
Robert Mitchell
Jet Propulsion Laboratory

Robert Mitchell,
Science Manager, Project Galileo
Jet Propulsion Laboratory
Pasadena, CA



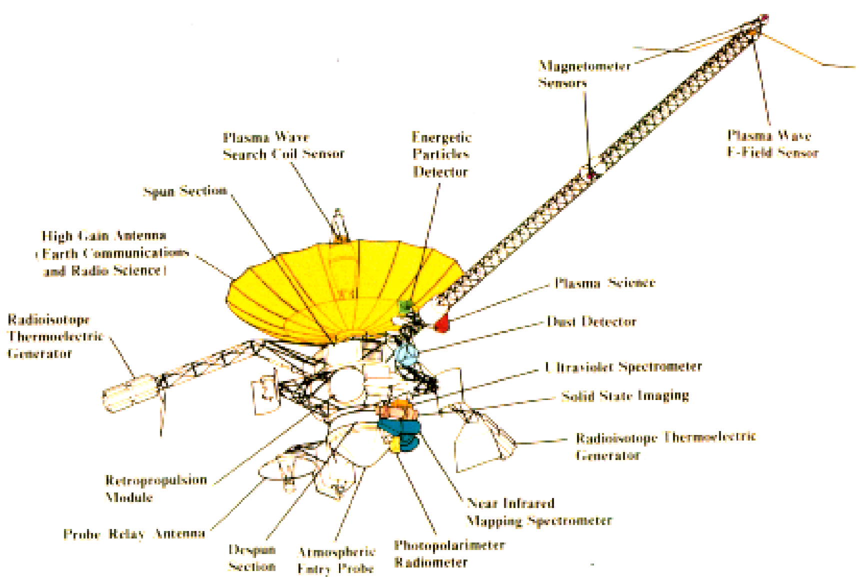
Galileo's scientific investigations will concentrate on Jupiter's atmosphere, magnetosphere, and satellites. The spacecraft's telescopes will improve on the best resolution obtained by Voyager by a factor of hundreds, and on the original observations of Jupiter and its satellites made by Galileo Galilei by a factor of as much as one million.

The Galileo spacecraft was launched on October 18, 1989, at about 1:00 p.m. EDT, on the Space Shuttle Atlantis, beginning its six year journey to Jupiter.



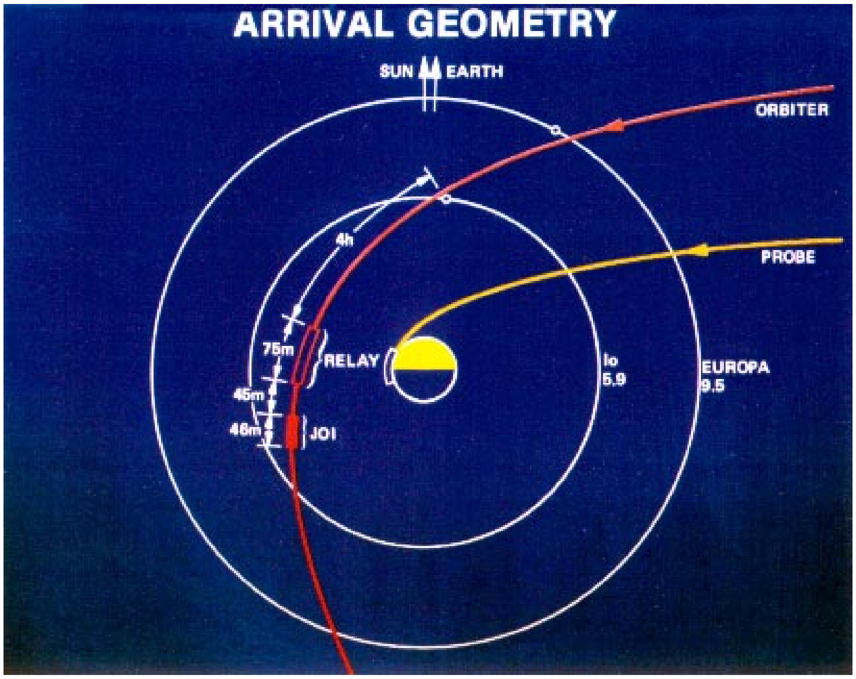
With the advent of the Challenger accident and the subsequent decision not to use the Centaur upper stage in the shuttle, Galileo needed to find a way to get to Jupiter using the smaller Inertial Upper Stage (IUS) The result was the development and design of the Venus-Earth-Earth Gravity Assist (VEEGA) trajectory that succeeded in delivering Galileo to Jupiter using an upper stage capability only adequate to launch the craft to Venus.

The Galileo spacecraft consists of a spinning section which provides attitude stability and a rotating platform for the six fields and particles instruments, and an inertially fixed de-spun section which carries a scan platform on which the four remote sensing instruments are mounted. The antenna for receiving the probe signal on the orbiter is also mounted on the de- spun section. Electrical power is provided by two RTGs mounted on deployable booms to protect the spacecraft from heat and radiation generated by the units.



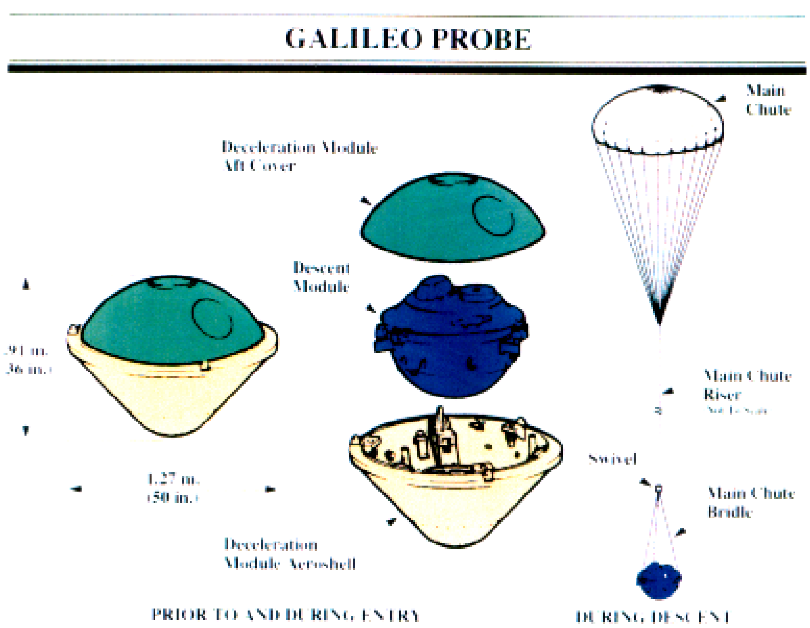
This view of the moon in orbit about Earth was taken 8 days after the second encounter with Earth, at a range of just over 6 million km. The moon is in the foreground, with its orbital motion from left to right. Antarctica is visible through the clouds at the bottom of Earth's disk. Some of the moon's far side can also be seen. The shadowy indentation in the terminator is the south pole-Aiken Basin, the largest impact basin in the solar system. The moon's brightness has been exaggerated in order to show details better.

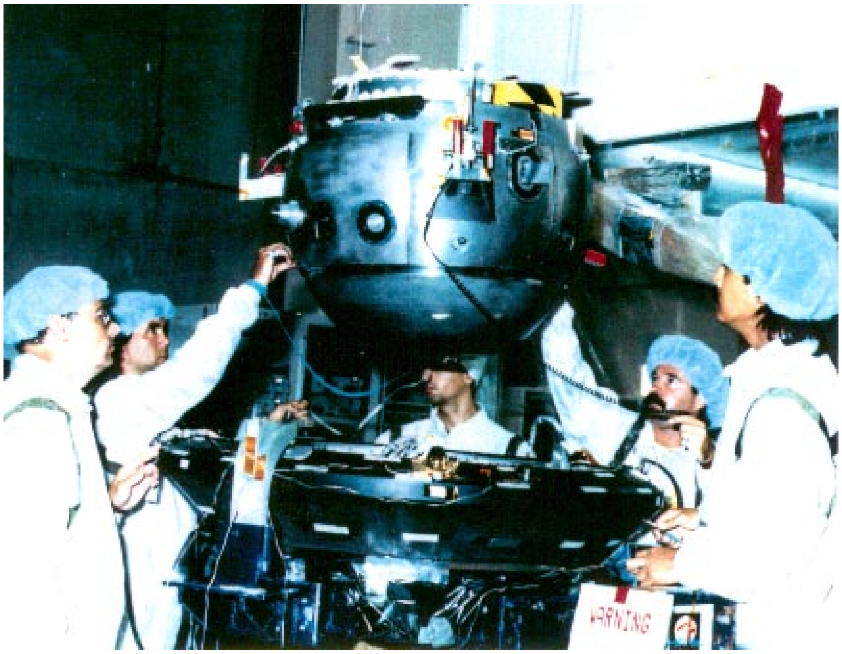
This image of asteroid 243 Ida and its newly discovered satellite Dactyl was taken 14 minutes before closest approach on August 28, 1993. Ida is about 56 km in its long axis, and Dactyl is approximately spherical and about 1.5 km in diameter. This is the first known natural satellite of an asteroid. Dactyl is not identical in spectral properties to any area of Ida in view here, though its overall similarity in reflectance and general spectral type suggests that it is made of the same rock types.



This shows the separate paths of the probe and orbiter during the approach to Jupiter, the entry, data relay, and orbit insertion. The orbiter passed 32000 km from Europa, 1000 km from Io, and 3 Jupiter radii above the atmosphere of Jupiter, closer than it will come again during its two year orbital mission because of concerns about the radiation environment. The probe entered in daylight and was carried into night by the rotation of Jupiter during its 57 minute mission.

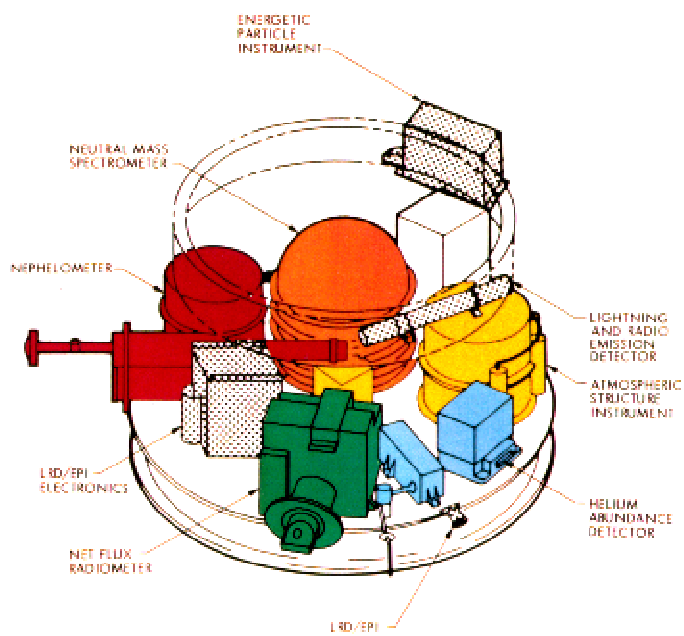
The Galileo atmospheric probe is composed of two major segments - the descent module (center middle), and the deceleration module with heat shield (lower center) and aft cover (upper center). The descent module falls slowly through the jovian atmosphere on a parachute while the prime science data are gathered. It contains the science instruments and the subsystems required to support the instruments and transmit the data to the orbiter flying overhead, which captures the data for later relay to Earth. The deceleration module includes the heat shields, the structure that supports the heat shields, and the thermal control hardware for mission phases up to atmospheric entry.

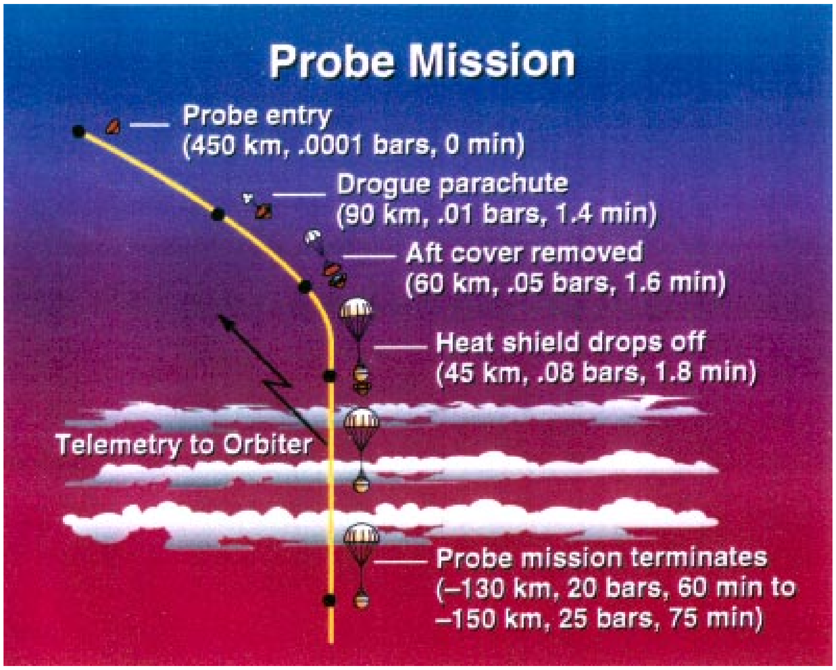




This photograph shows the probe descent module being assembled into the aeroshell at the Kennedy Space Center.

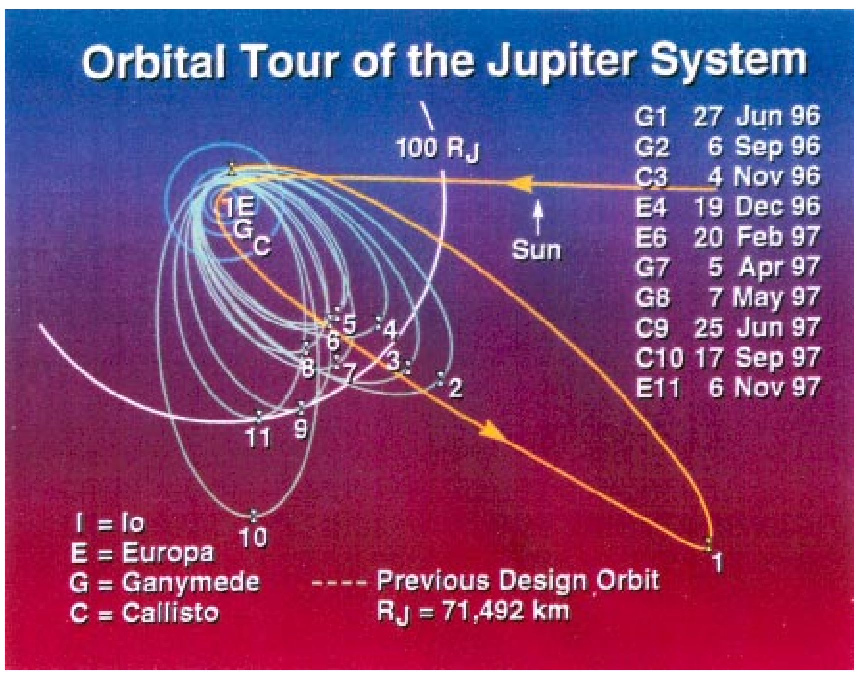
This sketch shows the layout of the six scientific instruments carried on the probe. The instruments consist of a neutral mass spectrometer, an atmospheric structure instrument, a nephelometer, a helium abundance detector, an energetic particle/radio emission detector (actually two different detectors sharing common electronics), and a net flux radiometer. Additionally, atmospheric winds were measured using the Doppler shift on the radio signal received by the orbiter from the probe

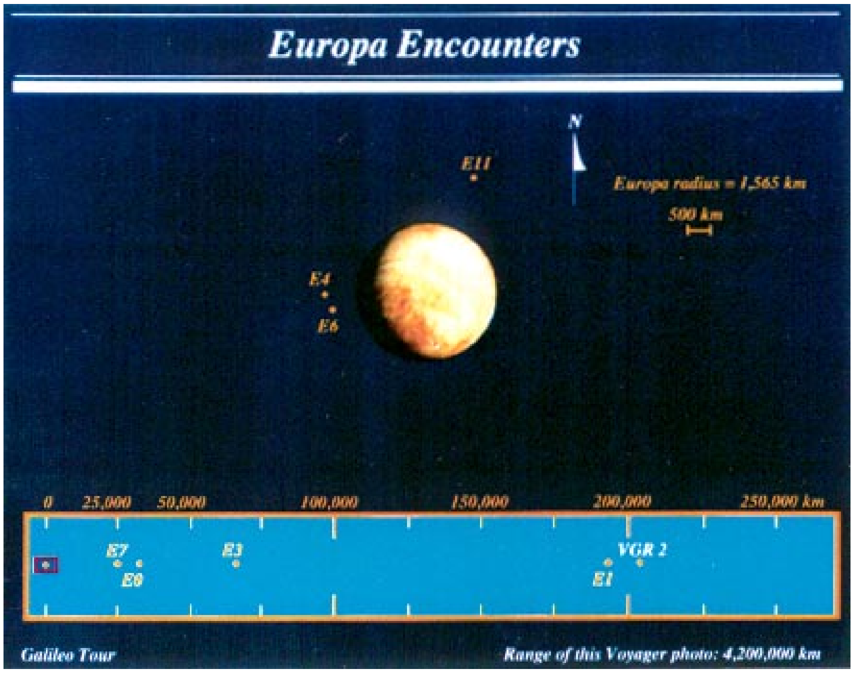




The probe mission began when a pre-set timer onboard turned the instruments and radio system on 6 hours before entry. From this point the sequence shown was followed, from entry at 450 km above the 1 bar reference altitude, to about 60 minutes later (57.6 minutes of in-lock telemetry with the orbiter) at an atmospheric pressure of about 23 bars.

The Galileo orbiter entered orbit around Jupiter on December 7, 1995. It is now headed for its first satellite encounter in the orbital tour, Ganymede, on June 27, 1996. The tour lasts for about two years, and consists of a total of ten close targeted encounters with Ganymede, Europa, and Callisto. Somewhat more distant monitoring of Io will be performed, and extended periods of continuous measurements of the environment within the magnetosphere are planned. Occultations of Earth and the sun and flux tube and wake passages provide additional opportunities for scientific observations.





The aim points for Galileo's three closest encounters with Europa are shown to scale on this Voyager image. Since Galileo will pass up to 350 times closer to the surface of Europa than Voyager, comparable increases in resolution are expected. The entire frame of the slide is contained within the red box at the left of the blue strip across the bottom to illustrate the difference in closest approach distances. The Voyager closest encounter is shown in the blue box at just over 200,000 km.